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Intolerable Risk: Pesticides in our Children's Food

A Report by the
Natural Resources Defense Council

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Executive Summary

Our nation's children are being harmed by the very fruits and vegetables we tell them will make them grow up healthy and strong. These staples of children's diets routinely, and lawfully, contain dangerous amounts of pesticides, which pose an increased risk of cancer, neurobehavioral damage, and other health problems. Although solutions are at hand, little is being done by the government to protect children from the intolerable risk to their health posed by pesticide residues in food.

In 1986, the Natural Resources Defense Council (NRDC) began a major study to determine whether levels of pesticide residues currently found in fruits and vegetables pose a health hazard to preschoolers. The potential effects of pesticide residues on children were examined for several reasons. First, the typical child consumes fruits and vegetables at a significantly greater rate than adults. With this increased intake comes greater relative exposure to pesticides present in food. Second, children may be more vulnerable to the effects of toxic chemicals, including pesticides. Experimental studies have found that the young are frequently more susceptible than adults to carcinogens and neurotoxins. Finally, although the Environmental Protection Agency (EPA) acknowledged in 1987 that children are invariably exposed to the highest levels of pesticides in food, neither the preschooler's dietary exposure to pesticides nor the resultant health risk has been previously quantified in a comprehensive manner. NRDC's report, therefore, represents the first detailed analysis of children's exposure to pesticides in food and a determination of the potential hazard that these residues pose to children.

Methodology

NRDC estimated the health risk to preschoolers during their first six years of life (0–5 years) by determining consumption rates for food items most frequently eaten by children. Data on the quantities of 23 pesticides known to have adverse health effects and commonly detected in these foods were obtained from federal government regulatory programs. Preschoolers' exposure to these 23 pesticides was determined by combining children's consumption rates for the food types with actual pesticide residue levels found in these foods. Pesticide exposure estimates were then assessed to determine preschoolers' risk of developing cancer or experiencing a disruption in central nervous system function. These toxicological endpoints were selected because 20 of the 23 pesticides evaluated in this report are either neurotoxic or carcinogenic. Furthermore, risk assessment procedures for these health effects are fairly well established. Figure S-1 provides a schematic representation of the methodology

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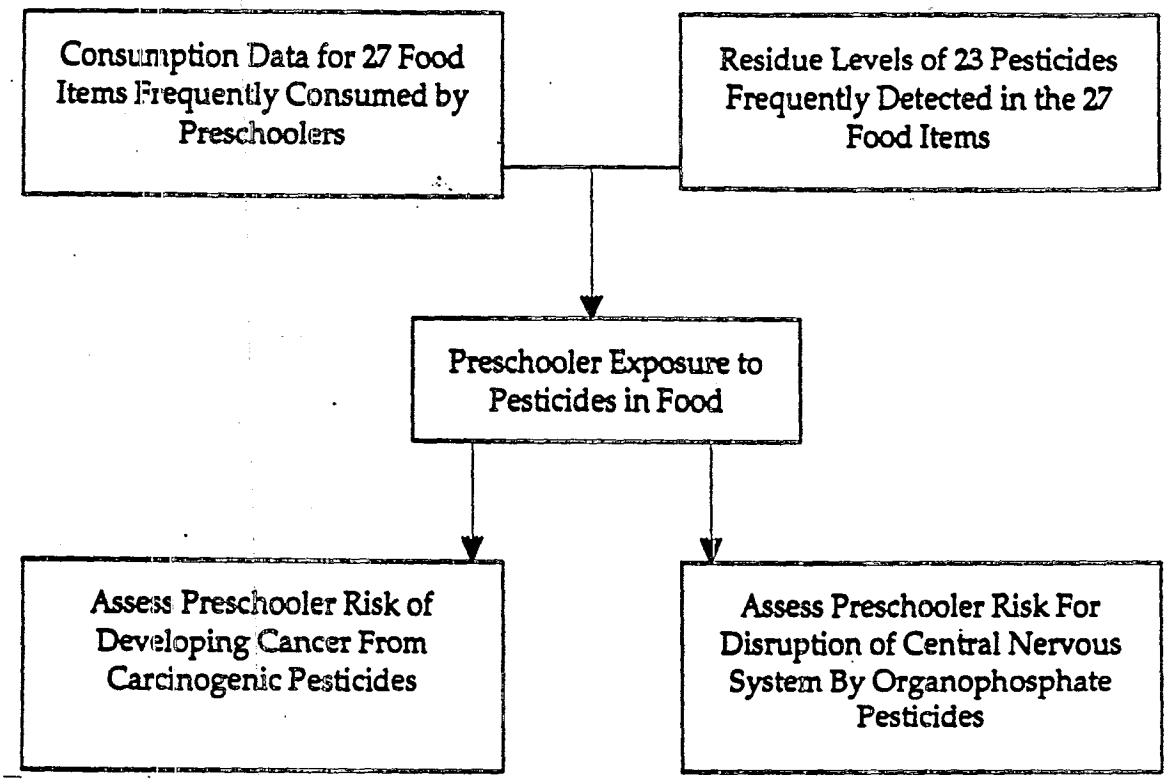
Figure S-1. Methodology of NRDC Study to Estimate Preschoolers' Health Risk From Pesticides in Foods



To develop an adequate database of preschooler exposure to pesticides, NRDC used consumption data from a nationwide food consumption survey conducted in 1985 by the U.S. Department of Agriculture (USDA) of children and adult women, and data on residue levels of 23 pesticides (and important metabolites) actually measured in types of fruits and vegetables. The data on pesticide residues in produce were derived from analyses of over 12,000 food samples conducted under regulatory programs of the Food and Drug Administration (FDA) and the EPA.

Principal Findings

Preschoolers are being exposed to hazardous levels of pesticides in fruits and vegetables. Between 5,500 and 6,200 (a risk range of 2.5×10^{-4} to 2.8×10^{-4}) of the current population of American preschoolers may eventually get cancer solely as a result of their exposure before six years of age to eight pesticides or metabolites commonly found in fruits and vegetables.[1] These estimates are based on scientifically conservative risk assessment procedures. They indicate that more than 50% of a person's lifetime cancer risk from exposure to carcinogenic pesticides

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used on fruit is typically incurred in the first six years of life.

The potent carcinogen, unsymmetrical dimethylhydrazine (UDMH), a breakdown product of the pesticide daminozide, is the greatest source of the cancer risk identified by NRDC. The average preschooler's UDMH exposure during the first six years of life alone is estimated to result in a cancer risk of approximately one case for every 4,200 preschoolers exposed. This risk is 240 times greater than the cancer risk considered acceptable by EPA following a full lifetime of exposure.[2] For children who are heavy consumers of the foods that may contain UDMH residues, NRDC predicts one additional cancer case for approximately every 1,100 children, a risk 910 times greater than EPA's acceptable level.

The carcinogenic risk estimates for daminozide are based on results of a 1986 market basket survey that EPA required the manufacturers of daminozide to conduct. Although daminozide use may have decreased since 1986, there is no reliable information on whether—or to what degree—use has decreased. EPA has recently stated that approximately 5% of apples are treated with daminozide. However, this figure was derived from informal conversations with growers, who may have a strong self-interest in portraying their products as daminozide-free. In contrast to EPA's figure, one Uniroyal manager privately stated that 10–11% of the nation's apple acreage was treated with daminozide in 1988. Further, an independent laboratory found in 1988 that 30% of apples tested from one large supermarket chain contained daminozide. More recently, a survey indicated that 23% of Vermont's apple acreage was treated with daminozide. These data were not considered when EPA developed its use estimate and raise serious questions about the accuracy of the Agency's figure. In the absence of government testing to verify grower claims about daminozide use, the manufacturer's 1986 market basket survey remains the only accurate indicator of actual residues in food.

Preschoolers also receive unacceptable exposure to the carcinogenic fungicides captan, chlorothalonil, folpet, and ethylenethiourea (ETU), the metabolite of the fungicide mancozeb. NRDC estimates that average exposure to these pesticides from consumption of fruits and vegetables from birth through age five may present a lifetime risk of one cancer case for every 33,000 to 160,000 children exposed. That means that out of the current preschool population, between 140 to 670 children may develop cancer sometime during their lifetime as a result of exposure to these fungicides. These risk estimates are approximately two to seven times what EPA considers acceptable following a full lifetime of exposure. These estimates are unchanged by EPA's recent decision to cancel certain food uses of captan since none of the food uses contributing to preschoolers' risk in our calculation were cancelled by EPA.

Of equal concern is NRDC's estimate that at least 17% of the preschool population, or three million children, receive exposure to neurotoxic organophosphate insecticides just from *raw* fruits and vegetables that are above levels the federal government considers safe. High level exposure to these insecticides can cause nausea, convulsions, coma and even death. Dietary exposure received by preschoolers may induce behavioral impairments and alter neurological function.

NRDC's analysis of exposure, based on studies of food consumption by children and women, determined that, relative to their weight, preschoolers receive much greater exposure than adults to the majority of the pesticides analyzed in this report. The average preschooler receives more than five times greater exposure to the fungicide mancozeb, nine times greater exposure to the

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neurotoxic organophosphate azinphos-methyl and 12 times greater exposure to UDMH, the carcinogenic metabolite of daminozide, than adults. The typical preschooler receives four times greater exposure, on average, than adults to the eight carcinogenic pesticides evaluated. The youngest children receive the greatest pesticide exposure. Relative to adult women, toddlers receive more than eight times the exposure to mancozeb, 15 times greater exposure to azinphos-methyl and 18 times greater exposure to UDMH.

Preschoolers have greater exposure to pesticide residues than adults because they eat more food, relative to their weight, and consume much larger quantities of fruit, which have a high likelihood of being contaminated with pesticides. Fruit comprises 20% of the adult diet and 34% of the preschooler's diet. Preschoolers eat six times as much total fruit, seven times more grape products and seven times more apples and apple sauce, relative to their weight, than adults. Apple juice is a particular favorite of children. The typical preschool child consumes almost 18 times as much apple juice and the typical toddler more than 31 times as much apple juice, relative to his/her weight, than the average adult woman.

Fruit is highly likely to contain pesticide residues. The 1987 FDA's food monitoring program found that 50% of all fruit samples had detectable levels of pesticides. This contamination rate is higher than that of any other commodity and may significantly underestimate the full extent of contamination. Routine FDA monitoring methods cannot detect approximately 60% of the pesticides likely to leave residues on food, including many carcinogenic fungicides used widely on fruit.

Report Findings May Underestimate Preschooler Risk

The NRDC study may significantly underestimate the full extent of preschooler exposure and the subsequent health risk from pesticides in food for several reasons. First, this study assesses cancer risk that results from exposure only from birth through age five to pesticides in food. The total lifetime cancer risk will be greater since estimates do not include risk incurred from age six to 70+ years. Further, this study assesses the health risk from only 23 pesticides out of the 300 that can be legally used on food. Of the 66 pesticides EPA believes to be potentially carcinogenic and allows to be used on food, only eight were evaluated by NRDC. Routinely used FDA monitoring methods—from which much of the residue data used in the NRDC analysis were obtained—can detect only approximately 40% of the pesticides likely to leave residues on foods. Of all food use pesticides classified by the federal government as posing a moderate to high health hazard approximately 40% cannot be detected by FDA monitoring techniques.

NRDC has only assessed exposure from fruits and vegetables out of the many commodities that are consumed daily by preschoolers and that may contain pesticide residues. Milk products are perhaps the most conspicuous of the foods absent from the exposure estimates. The average preschooler has a milk intake that is almost five times higher than that of the typical woman. EPA estimates that 60% or more of the preschooler's exposure to the carcinogenic fungicide captan, for example, may come from residues in milk. EPA's recent cancellation of the minor food uses of captan does not appear to reduce this estimated exposure from milk. Pesticides get into animal products, including meat and eggs, as well as milk, via

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pesticide–contaminated feed. Drinking water may also be a significant source of pesticide exposure, especially in rural areas. EPA has reported that the normal agricultural use of pesticides has resulted in detectable concentrations of 46 pesticides in the groundwater of 26 states.

This report focuses primarily on the risk of developing cancer or the probability of disruption of normal nervous system function from dietary exposure to pesticides. However, many of the pesticides in the study cause additional adverse health effects, such as damage to the kidney or liver, effects on the immune system, or changes in reproductive capacity. Further, the full impact on preschooler health from exposure to pesticides in food is unknown since the majority of the 600 active pesticide ingredients (representing 50,000 pesticide products actually in use) have not been tested according to modern testing requirements, or the test data are unacceptable by today's standards. The National Academy of Sciences (NAS) concluded in 1984, based on an analysis of a representative sample of pesticides, that data needed to conduct a complete health hazard assessment were available for only 10% of the pesticide products on the market. Of the 23 pesticides evaluated for NRDC's study, 19 (83%) were registered by USDA in the 1950s and 1960s before any comprehensive testing requirements were in place. EPA simply adopted their registrations later.

This study underestimates the risks to children for a number of other important reasons. Children are likely to be more susceptible to the effects of nervous–system toxins and cancer–causing chemicals than we have assumed in making our estimates. However, data regarding the degree of enhanced sensitivity in preschoolers were not available for the specific pesticides evaluated in this report; therefore, susceptibility could not be factored into our health risk assessment.

The government does not require adequate testing for neurotoxic effects of pesticides. Long–term neurological testing for chronic effects of organophosphates and other neurotoxic pesticides is not required; the current tests assess only if the pesticide is capable of causing a specific delayed paralytic reaction following acute and subacute exposure.

Finally, "inert" ingredients, which act as the delivery vehicles for the active ingredients, are not regulated, even though many are known to cause cancer or other health hazards. Moreover, EPA has historically not required submission of health or safety information on "inerts". These compounds, labeled "inert" because they have no pest–killing action, have been exempted from federal requirements for setting permissible residue levels for pesticides in food.

Children's Physiological Vulnerability to Toxic Chemicals

Preschool children are receiving hazardous exposures to pesticides at the time when they are likely to be most susceptible to the toxic effects of these compounds. Experimental tests in laboratory animals have found the young to be more vulnerable than adults to the toxic effects of many chemicals, including a number of pesticides, due to their immature physiological systems. Studies have found that the young of various species retain a greater portion of a given dose of certain toxins than adults, because gastrointestinal absorption is increased and elimination is decreased. Further, the young are not capable of detoxifying many chemicals because detoxification enzymes are not fully functional. Young bodies are not capable of segregating toxins from the target organs.

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Numerous studies have found that there is a greater risk of developing cancer if exposure to carcinogens begins during infancy rather than later in life. One reason that the young are more susceptible than adults to carcinogens is because cells are dividing rapidly during childhood. The cancer process is typically started when a carcinogen interacts with a cell's DNA, causing a mutation. If cells are dividing rapidly following exposure to a carcinogen capable of mutating DNA, there is a greater probability that the mutation of DNA will be fixed and the carcinogenic event initiated. In addition, the young may be at greater risk of developing cancer because they have a greater probability compared to adults of surviving the latency period prior to the manifestation of cancer.

The young have also been shown to be at greater risk from exposure to a number of neurotoxins, including neurotoxic pesticides. For instance, young rats are more susceptible than adults to the acute effects of 15 out of 16 organophosphate pesticides tested. In addition, experimental studies indicate that exposure to organophosphates and carbamate pesticides during the period of nervous system development surrounding birth may alter neurological function and may cause subtle and long-lasting neurobehavioral impairments.

Inadequate Government Programs

Current federal regulation of pesticides fails to protect the preschooler. EPA has virtually ignored infant and child food consumption patterns when regulating pesticides. Current legal limits for pesticides, or tolerances, in food are based on data collected over two decades ago on adult consumption levels. The consumption estimates that have been used by EPA in setting almost all current legal limits for pesticide residues on produce greatly underestimate preschooler intakes for most produce. Preschooler consumption of cranberries is 14 times greater than EPA's estimates; consumption of grapes is six times greater; apples and oranges, five times greater; apricots, almost four times greater; strawberries, almost three times greater; broccoli, two-and-a-half times greater; carrots, two times greater; and tomatoes, one-and-a-half times greater than EPA's estimates.

Because EPA has neglected preschooler consumption rates, the preschooler's maximum legally permissible exposure to many pesticides is hundreds of times higher than the level that EPA considers safe. The average preschooler exposure at legal limits to any one of the carcinogens captan, folpet and mancozeb, would present a risk of approximately one cancer case for every 2,000 to 3,000 children exposed simply during their first six years of life (340–460 times greater than EPA's "safe" standard of one cancer case per million following a full lifetime of exposure). Although EPA recently cancelled several food uses of captan, none of the commodities contributed significantly to actual preschooler exposure to captan. In other words, EPA has permitted the continuation of the captan food uses that present preschoolers with the greatest risk.

Legal exposures to neurotoxic pesticides also pose unacceptable risks. Preschooler exposure at the legal limit to demeton, a neurotoxic pesticide, would exceed the EPA-determined safe level by approximately 400 fold; exposure to another neurotoxin, disulfoton, by approximately 180 fold; and to another, diazinon, by approximately 160 fold.

Recommendations for Reform

Fundamental reforms in federal regulation are necessary if preschoolers are to be

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adequately protected from pesticides in food. Immediate action is necessary to close the loopholes in EPA's and FDA's regulatory programs. Further, Congress must act to assist growers in reducing their use of pesticides.

Congress must establish health-based standards for pesticide residues in food and require EPA to regulate pesticides so that the most exposed and most vulnerable members of society—infants and children—are adequately protected. EPA's current practice of basing risk assessment on the average diet does not provide this protection. Exposure at the legal maximum, or the tolerance level, should be assumed when EPA conducts risk assessments. EPA must ensure that consumption of food with residues at the legal maximum is safe for everyone, including children.

Congress must clarify EPA's authority to revoke or modify tolerances swiftly when dietary exposures to pesticides are found to present significant risk. It currently takes years to lower tolerances or remove hazardous pesticides from the market. In addition, EPA must consider risks from "inert" ingredients when regulating pesticides. Further, EPA should prohibit the use of dangerous "inerts." Congress should require that pesticide registrants develop practical analytical methods to detect pesticide residues, which can be effectively used by the government in enforcing tolerances. Finally, neurotoxicity testing should be required for all pesticides used on food and should evaluate both acute and long-term adverse effects on such processes as learning ability, memory, intelligence and behavior.

FDA must improve its methods for detecting pesticides in food. Accurate and detailed pesticide use information for both domestic and imported produce must be obtained to facilitate the choice of analytical method used in food samples. To do this, FDA's monitoring resources must be enhanced. Congress should require FDA to accelerate its analysis of food samples and give FDA the authority to detain domestic food shipments to insure that food with illegal residues can be removed from the market before it is sold or consumed. In the vast majority of cases, FDA currently fails to take action to prevent illegal food from reaching the market and being sold.

Congress must assist growers in reducing pesticide residues, by providing credit assistance, crop insurance and other financial protection for growers who are changing from conventional, chemical intensive agricultural practices to innovative, low-input techniques. Congress should impose a tax on pesticide use to fund demonstration of farming techniques that will result in lower pesticide residues. Congress should establish national definitions of "integrated pest management" and "organic" farming techniques and develop a national certification process for commodities grown using these techniques. Congress should modify federal farm support programs to reward growers for using fewer chemicals and ensure that growers are permitted to use crop rotation and other pesticide-reducing techniques without jeopardizing their eligibility for commodity program benefits. Congress should legislatively modify agricultural supply-control systems to ensure that they do not create demand for cosmetically perfect produce which require excessive pesticide use.

Consumer Action

There are measures for limiting an individual's exposure to pesticides in food. However, specific advice is difficult to offer because data on this issue are generally scarce. The steps include: washing all produce, preferably with a diluted solution of dishwashing soap; buying domestically grown produce, preferably in season; pur-

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chasing organically grown fruits and vegetables; and being wary of perfect looking produce since it may contain higher pesticide residues. Ultimately, the best way to minimize the presence of pesticide residues in food is by reducing the widespread use of these chemicals in agriculture. Consumers can accelerate this transition in agriculture through their power in the market place. By demanding food without pesticide residues, consumers will deliver a clear message to our food producers and provide an incentive for farmers to decrease their use of pesticides.

Report Format

The NRDC study is arranged as follows: Chapter One examines food consumption differences between preschool children and adult women and quantifies the preschooler's exposure to 23 pesticides from consumption of different fruits and vegetables. Chapter Two estimates the potential health risk to preschoolers from exposure to these 23 pesticides, with emphasis on cancer risk and nervous system effects. Chapter Three examines the physiological immaturities of the young that make them more susceptible to the toxic effects of chemicals. Chapter Four describes the flaws in the government's regulation of pesticides that permit preschoolers to be exposed to significant health risks. Chapter Five recommends congressional measures necessary to reform these regulatory programs and make the food supply safe from pesticides. Chapter Six offers advice on how to reduce an individual's exposure to pesticide residues. There are three technical appendices. Appendix One contains a detailed description of the methodology used to estimate the preschooler's exposure to the 23 pesticides analyzed. Appendix Two explains the methodology used to conduct the health risk assessments for exposure to organophosphate insecticides. Appendix Three sets forth the methodology used to make the carcinogenic risk assessments.

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Addendum

Ten days prior to publication of this report, EPA cancelled a number of food uses for the pesticide captan. However, the EPA action does not change NRDC's estimates of the carcinogenic risk captan poses to preschoolers presented on pages 3, 37, 38, 39 and 40 of this report. The NRDC estimates are for the lifetime cancer risk that results just from preschooler exposure to dietary residues of captan typically found only in the 27 fruits and vegetables examined in this report. NRDC's risk estimates for cancer are unchanged by EPA's action because none of the food uses contributing to preschooler risk were cancelled by EPA. In fact, EPA has allowed the use of captan to continue on strawberries, apples, grapes, and plums — all major dietary sources of preschoolers' exposure to the pesticide.

EPA's action does decrease NRDC's calculation of the preschooler's maximum legally allowed exposure to all uses of captan, and the resulting cancer risk, from 4.6×10^{-4} to 2.8×10^{-4}. These are lifetime estimates of the risk from maximum legal exposure just during the preschool years and were calculated for all foods for which tolerances for captan had been granted, assuming exposures at the tolerance limit. They are presented on pages 6, 74 and 75. EPA's recent action reduces the preschooler's maximum legal cancer risk for exposures occurring only until age six from 460 times greater than EPA's "safe" standard of one cancer per million people exposed over their entire lifetimes, to a risk 280 times greater.

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Notes

1. These estimates are based on consumption statistics of preschoolers in the 1985 USDA survey who completed three or more days of the dietary survey over the course of a year. These data were used to approximate average daily exposure over the year. However, cancer risk estimates were also made based on daily intake for all preschoolers in the survey and result in an estimated 5,700 to 6,400 additional cancer cases (2.6×10^{-4} to 2.9×10^{-4}) in the preschool population.

2. Using daily intake for all preschoolers in the survey (see footnote 1), UDMH still accounts for the majority of the cancer risk, which is 250 times the level EPA considers acceptable following a full lifetime of exposure.

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